PATENT SPECIFICATION

674,240

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COMPLETE SPECIFICATION

Improvements in or relating to Silica Bricks

I, WILLIAM DAVID JONES, Chartered Patent Agent, of 33, St. Mary Street, Cardiff, a British Subject, do hereby declare the invention, (Communicated by Dr. C. Otto & Comp. G.m.b.H. of Bochum, Germany, a Company organized according to the laws of Germany), for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly

brick near the surface so that the core of the brick was deficient of these substances. Realisation of this behaviour resulted in a proposal to employ a fused mixture of alkaline metal compounds thereof, magnetite and quartz which was insoluble in water. This insoluble mineralizer succeeded in causing good crystal transformation of the silica mass but cracks still appeared in the larger

ERRATUM

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Page 2, line 93, *after* "broken" *insert* "quartzites, gravel, flint stones and like".

THE PATENT OFFICE,
3rd November, 1952

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materials such as sand, gravel, quartzites and flint which are readily available but, depending on their degree of chemical purity, their capacity for crystal transformation is sometimes so poor that hitherto they were not suitable for use as raw materials in the manufacture of silica bricks. At best one or more of these materials could only be used as aggregate.

It is well known that the crystal formation of quartz can be accelerated by adding mineralizers such as, for example, alkaline metals or compounds thereof. Such addition however involves certain disadvantages as the presence of the mineralizers often accelerates the crystal transformation to such a degree that sudden swelling causes the bricks to crack. Furthermore, it was not practicable to use soluble mineralizers because in the larger sizes of brick, during heating, the evaporating water carried the mineralizers to the marginal portions of the

while the material of the core had a high specific gravity. This is obviously due to the fact that the heat penetrates only slowly into the interior of the brick. An identical phenomenon is observable when a soluble mineralizer has been added to the silica mass from which the brick is made.

These observations have led to the invention according to which a process of manufacturing bricks from highly siliceous sands, broken quartzites, flint stones, gravel and like siliceous materials comprises the preliminary step of heating the material in grain form while maintaining it in constant motion until a crystal transformation of the material is effected and subsequently using such preheated material to form a brick.

The material which has been preheated may be mixed with other siliceous material which has not been so heated in the subsequent manufacture of a brick.

A mineralizer may be added to the

material which is pre-heated and this mineralizer may be soluble, for example sodium chloride, sodium carbonate or potassium carbonate may be used in aqueous solution.

When the mixture of siliceous material and mineralizer is heated while it is maintained in constant motion, for example in a rotary drum or kiln, practically each grain of the material comes into contact with the mineralizer.

Furthermore, when the material, or mixture of material and mineralizer, is kept in constant motion while being heated, the effect is to reduce the mass of the material heated at any moment to only a fraction of the mass which hitherto had to be heated. Consequently it becomes possible to heat each individual grain or particle of the material to such temperature as produces the partial or complete transformation into tridymite or cristobalite in a fraction of the time needed for sufficiently heating silica bricks.

The pre-heating or baking is preferably carried out in a rotary kiln and the temperature and duration of heating determined so that the major part of the quartz content of the material is transformed into either tridymite or cristobalite. For this purpose temperatures of up to 1550° Centrigrade are required.

The sand or other loose material which has been transformed into tridymite or cristobalite is, due to the modification of its structure which takes place, brittle and can therefore easily be comminuted. It is sufficient to grind the material in a pug mill and then to mix it with the usual quantity of calcium hydroxide, sulphite solution and water and proceed to make the bricks in known manner.

Another method of preparing a silica mass is as follows: One part of the pre-baked sand or other siliceous material is reduced to a desired grain size in mills such as are generally used in the fine ceramic industry, for example in drum mills which are provided with a flint lining and in which flint stones serve as grinding bodies. For grinding, the sand is preferably wetted so that it must subsequently be dried in a centrifuge. Fine ground and coarse sands are then mixed in a pug mill with lime and sulphate solution and the mixture is subsequently moulded into desired shapes.

After the moulded bricks have been dried they may be fired in a tunnel kiln the highest temperature of which is approximately in the range 1350° to 1400° Centrigrade, tridymite appearing at a lower temperature than does cristobalite, the heating and cooling rates in the range between 0° and 300° must be substantially lower than the rates outside this temperature range. Silica bricks made by the process provided by the invention are dimensionally accurate as compared with bricks made by other known processes as they swell only slightly during firing.

It will be understood that the silica mass from which bricks are moulded may be only partly formed by material which has been preheated as described.

It will be understood that materials which occur in bulk form or as large pieces, e.g. quartzite and flint stones are crushed and reduced to the desired grain form and suitably to the grain size of sand in its natural state.

The pre-baked material may be ground to grain sizes such as are described in the Complete Specification accompanying my co-pending Application No. 925 dated the 13th, January, 1949 (Serial No. 669,895) and the proportions of fine and coarse grain pre-baked material may be those disclosed in said specification.

What I claim is:—

1. The process of manufacturing silica bricks from highly siliceous sands, broken siliceous materials which comprises the preliminary step of heating the material in grain form while maintaining it in constant motion until a crystal transformation of the material is effected and subsequently using such pre-heated material to form a brick.

2. The process as claimed in Claim 1 which comprises heating the material until the quartzite content of the material is transformed into a later stage of crystallization for example tridymite.

3. The process as claimed in Claim 2 wherein the material is heated until the quartzite content of the material is wholly or partly transformed into cristobalite.

4. The process as claimed in any of the preceding claims wherein the material is heated to a tempertaure of 1550° Centigrade or approximately 1550° Centigrade.

5. The process as claimed in any of the preceding claims wherein the material is heated in a rotary kiln.

6. The process as claimed in any of the preceding claims wherein a mineralizer is added to the material to be heated.

7. The process as claimed in Claim 6 wherein the material to be heated is intimately mixed with an aqueous solution of a mineralizer before being heated.

8. The process as claimed in Claim 6 or Claim 7 wherein the mineralizer comprises sodium chloride or sodium carbonate or potassium carbonate.

9. The process of manufacturing silica bricks which comprises mixing material which has been subjected to a preliminary

heating process as claimed in any of the preceding claims with siliceous material which has not been subjected to such preliminary process.

10. Silica bricks made by the process claimed in any of the preceding claims.

11. The process of manufacturing silica bricks which includes subjecting siliceous material to a preliminary heating process substantially as described herein.

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PROVISIONAL SPECIFICATION

Improvements in or relating to Silica Bricks

I, WILLIAM DAVID JONES, Chartered Patent Agent, of 33, St. Mary Street, Cardiff, a British Subject, do hereby declare the nature of this invention (Communicated by Dr. C. Otto & Comp. G.m.b.H. of Bochum, Germany, a Company organised according to the laws of Germany), to be as follows:—

In the co-pending Application No. 925/1949 (Serial No. 669,895) it is described how it is possible to manufacture silica bricks having high mechanical compression qualities (high pressure softening value) from highly siliceous sands when a comparatively large proportion of the sand has been ground to a grain size of about 0.01 millimetres or less. When burning bricks made in this manner a rapid transformation of the quartz into later stages of crystallization takes place and the bricks have little porosity.

The sand grain sizes in a mixture which has proved successful in carrying out the process described in the co-pending Application were as follows:—

60 per cent of the mixture was composed of silver sand of grains larger than 0.3 mm. The remaining 40 per cent consisted of ground silver sand which an analysis by sedimentation gave the following contents:—

Grains over 0.03 mm. - - - - - -	nil
Grains between 0.02 mm. and over 0.03 mm.	11.4 per cent.
Grains between 0.01 mm. and 0.02 mm. - -	22.0 per cent.
Grains between 0.005 mm. and 0.01 mm. - -	25.5 per cent.
Grains less than 0.005 mm. - - - - - -	41.1 per cent.

The crystal transformation into tridymite can be accelerated in known manner by adding mineralizers, for instance alkali oxides. It has been noted that when burning larger sizes, the transformation into tridymite—which is recognisable by its lower specific weight—takes place only in the marginal layers whereas the specific weight remained larger toward the centre of the moulded brick. This is clearly due to the fact that the heat penetrates only slowly into the interior of the brick and the soluble mineralizers are carried along with the evaporating water to be precipitated mainly in the marginal layers of the brick.

This observation has led to the invention according to which a method of making bricks from highly siliceous sand comprises the preliminary step of baking the sand while maintaining it in continuous motion.

Preferably a mineralizer is added to the sand which is to be prebaked.

In another aspect thereof the invention comprises the preliminary step of effecting the crystal transformation of the said quartz into tridymite.

The method according to the invention can be carried out with the addition of water-soluble mineralizers, for example Na_2, CO_3, K_2, CO_3 and Na Cl, the dissolved salt being mixed with the sand. Drying the sand while it is in continuous motion, for example in a drum, makes it possible to bring the mineralizer into contact with practically each sand particle.

When a highly siliceous sand, to which a mineralizer has been added, is heated while it is in constant motion the mass being heated is, in effect, reduced in size and its is consequently possible to bring the individual quartz particle to the temperature required to transform it into tridymite in a fraction of the time normally required to make silica bricks.

The preliminary baking can suitably be carried out in a rotary kiln. The baking temperature and the baking time are chosen so that the greater part of the quartz is transformed into tridymite. This requires a temperature of about 1550 degrees C. The sand with the quartz thus transformed into tridymite is, in consequence of its altered structure, brittle and can easily be changed to a finer grain size. It is sufficient for this purpose to grind the sand in a grinding mill for a suitable length of time, then mix with the usual quantity of hydrate of lime, sulphite lye and water and form bricks from this mixture.

Another manner of producing the silica mixture is to bring a proportion of the

pre-baked sand to the required grain size in a mill of the kind customarily used in the fine ceramics art, particularly drum-mills which are lined with flint and in which flint is used as a grinding medium. The grinding is preferably done wet, the water used having subsequently to be removed, for example by a centrifuge. Finely ground sand and coarse sand are then mixed with lime and sulphite lye in a grinding mill and subsequently moulded into bricks.

For the composition of the base material it is preferable to mix coarse and fine grain fractions of a highly siliceous sand in the complete absence of a medium size grain, which medium size grain would be of sizes between those of the coarse and fine grain fractions, or to keep the medium size grain fraction small. The extent of the medium grain size range depends on the kind of sand used and particularly on the method used to reduce the sand grain size. In general the medium grain sizes if present should lie in a range of at least about 1 to 10. In this case the fine grain, after the fashion of a liquid, can flow into the spaces between the coarser grains, without fear of a destruction of the brick structure during burning. Thus bricks can be produced having low porosity.

After drying, the moulded bricks may be burnt in a tunnel kiln, the maximum temperature of which should be in the region of 1350 degrees C to 1400 degrees C. As the crystal transformation points of tridymite are in the region of 100 degrees C. and 200 degrees C., the initial heating and the subsequent cooling in the region between zero and approximately 300 degrees C. must take place comparatively slowly, whereas above this the temperature curve of the burning process can rise steeply. Silica bricks made in this way are particularly accurate as regards their dimensions as after the pre-forming no growth takes place in the subsequent burning.

Dated this 18th day of May, 1949.

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